

**NATURAL RESOURCES CONSERVATION SERVICE**  
**CONSERVATION PRACTICE STANDARD**  
**FOREST STAND IMPROVEMENT**

(Acre)

**CODE 666**

**DEFINITION**

The manipulation of species composition, stand structure, and stocking by cutting or killing selected trees and understory vegetation.

**PURPOSES**

- To increase the quantity and quality of forest products, e.g., sawtimber, veneer, wood fiber, poles, pilings, maple syrup, naval stores, nuts, and fruits.
- To harvest forest products.
- To initiate forest stand regeneration.
- To reduce the potential of damage from wildfire, pests, and moisture stress.
- To restore natural plant communities.
- To achieve a desired understory plant community.
- To improve aesthetic, recreation, and open space values.
- To improve wildlife habitat.
- To improve water conservation and yield.

- To achieve a desired level of crop tree stocking and density.
- To increase carbon storage in selected crop trees.

**CONDITIONS WHERE PRACTICE APPLIES**

All forest land where improvement of forest resources is needed.

**CRITERIA**

**General Criteria Applicable to All Purposes**

The harvest-regeneration strategy will be identified for all planned forest improvement harvesting:

- Uneven-aged management systems (single tree selection, group selection, coppice selection).
- Even-aged management (clear-cut, seed-tree, shelterwood, coppice).

The extent or size of treatment area or intensity of the practice shall achieve the intended purpose.

Preferred tree and understory species are identified and retained to achieve all planned purposes.

Spacing, density, size class, number, and amounts of trees and understory species to be retained will follow established guidelines for the intended purposes.

Stocking guidelines shall contain stocking in terms of basal area, spacing, or trees per acre by species and size class distribution.

The method, felling direction, and timing of tree cutting for harvesting shall facilitate efficient and safe tree removal and protect sensitive areas such as vernal pools, riparian zones, threatened and endangered species and their habitat, cultural resources, and structures.

Forest stand improvement activities shall be performed to minimize soil erosion, compaction, rutting, and damage to remaining vegetation and hydrologic conditions.

Slash and debris left on the site after treatment will not present an unacceptable fire, safety, environmental, or pest hazard. Such remaining material will not interfere with the intended purpose or other management activities.

Comply with applicable federal, state, and local laws and regulations during the installation, operation, and maintenance of this practice, including Tennessee's Forestry Best Management Practice guidelines.

## CONSIDERATIONS

Silvicultural objectives and harvest-regeneration strategies may change over time and may be limited by prior management.

Harvesting is an integral part of forest management for both health and

productivity of the stand. If executed properly, it is only a temporary disturbance to the forest environment. Harvesting operations should be planned and conducted to minimize soil compaction, erosion, and sedimentation and to protect water quality. Successful regeneration of desirable species is usually dependent on timely application of forest stand improvement and other practices, e.g., prescribed burning, site preparation, tree and shrub establishment, prescribed grazing, and use exclusion.

The extent, timing, size of treatment area, or the intensity of the practice should be adjusted when feasible to minimize cumulative effects (on-site and off-site), e.g., hydrologic and stream alteration, habitat fragmentation, nutrient cycling, biodiversity, and visual resources.

Potential landowner and operator liability should be assessed before forest stand improvement activities begin.

The practice should be timed to minimize disturbance of seasonal wildlife activities.

Consider wildlife food and cover needs when making modifications to forest composition and tree spacing.

Consider retention of selected dead and dying trees, including down material, to enhance wildlife habitat values.

Landowners should secure a written contract with any service provider that specifically describes the extent of activity, duration of activity, responsibilities of each party, and amount and timing of payments for services provided.

Consider environmental concerns such as threatened and endangered species, cultural resources, and natural areas.

## PLANS AND SPECIFICATIONS

Specifications for applying this practice shall be prepared for each site and recorded using approved specification sheets, job sheets, technical notes, and narrative statements in the conservation plan, or other acceptable documentation.

### A. Pre-Commercial Release Measures

Measures are often performed on young stands to manipulate the stocking rate or control undesirable vegetation before the trees reach merchantability. Release components may include pre-commercial thinning, chemical release, or prescribed burning.

#### 1. Pre-commercial Thinning

Pre-commercial thinning may be needed in dense, natural stands and in plantations where the number of planted trees has been augmented with natural regeneration from surrounding stands.

This type of thinning should be performed when seedlings are well established, but before they reach 3 inches in diameter at breast height. The most effective results are achieved between ages two and five years.

The trees may be cut by use of a rotary mower, bulldozer, disk, or drum chopper, or by use of hand tools such as machete, axe, brush hook, and similar tools. Equipment used will depend on the size of the trees, the size of the area to be treated, site conditions, and the economic constraints set by the landowner.

Cut trees are generally left on the ground. Construction and maintenance of fire lanes is strongly recommended due to the high fuel levels and wildfire potential following pre-commercial thinning (See practice standard for Firebreak, Code 394).

#### 2. Chemical Release

Chemical herbicides may be applied to a forest stand to remove undesirable trees. Advantages of using chemical methods of release:

- Control of vegetation with little soil disturbance.
- They can be used on steeply sloping land where equipment limitations are severe.
- May be applied over large acreage quickly.
- Landowners with proper herbicide use certification and small tracts can treat their own property.
- Selectivity of chemicals allows targeting specific types of problem vegetation.
- Chemical treatments may be used when mechanical methods are impractical or are not cost-effective.

Timing of the chemical application is often critical. There are differences in the susceptibility of the various target species to different herbicides and differences in susceptibility during different stages of growth.

All these factors influence the proper timing of application. Most hardwood species are more susceptible to chemical action in the spring or early summer, but they can be treated at other times.

Landowners are always cautioned to strictly follow label directions for proper herbicide application and safety considerations.

Chemical herbicides can be applied by tree injection, foliar spraying, basal application, or soil application.

#### (a) Tree Injection

Chemical injection can be used to select individual medium to large size trees for removal. Tree injectors are used to apply a herbicide through cuts in the bark of the tree. A basal injector or hypo-hatchet may be used. Injections should be made at 2-3 inch intervals completely around the tree. Difficult to control species may need a continuous cut rather than spaced cuts. Injections should be done while the tree is actively growing.

Other tools commonly found around the homestead may also be used to apply the chemicals. A hatchet and plastic squeeze bottle can be effectively used to make the cut and apply the chemical.

#### (b) Foliar Spraying

Spraying herbicides can be done aurally from fixed wing aircraft or helicopters, or from the

ground with sprayers attached to backpacks, ATV's, tractors, skidders, or other ground equipment.

Foliar spray for release is generally applied during late summer and early fall before dormancy begins.

The potential for spray to drift onto untargeted and/or sensitive areas should be considered before making the decision to use this application method. Employ of a qualified and experienced applicator should reduce risk.

#### (c) Basal Application

With this method the herbicide is sprayed directly onto the bark of the tree at the base of the trunk of the tree to be removed. This method of treatment may generally be performed year round with the proper herbicide formulation.

#### (d) Soil Application

With this herbicide treatment, the chemical is sprayed onto or broadcast on the soil surface. The chemicals are washed into the root zone by rainwater, where they are taken up by the tree's root system. This treatment method is best performed in early spring as the trees are leafing out.

Care must be taken to not use this method near streams, where the chemical may be carried to non-targeted trees.

**(e) Prescribed Burning**

Prescribed burning may be used in pine stands to remove hardwood species and other ground vegetation that compete with the crop trees. See practice standard Prescribed Burning (338).

Due to the liability inherent with this treatment, it would be wise to hire a qualified and experienced technician to carry out the burn.

- Trees with injuries resulting from fire, ice, insects, lightning, etc.
- Deformed trees (forked, crooked, etc.) that have low value.
- Trees that are not well adapted to the site and have low growth rate, poor form, or poor health.
- Mature trees that have begun to decline in vigor.
- Tree species that are not compatible with the landowner's objectives.

**B. Commercial Release Measures**

Cutting in merchantable forest stands is done periodically to concentrate growth onto crop trees, to reduce susceptibility to disease and insects, to salvage low-quality or suppressed and dying trees, or to improve growth of ground cover for grazing by livestock or wildlife. These measures include intermediate thinning, harvest/regeneration cuts, salvage cuts, and sanitation cuts.

**1. Intermediate Thinning**

Cuts that manipulate conditions in a merchantable stand prior to a regeneration/harvest cutting are intermediate thinning. This type of cutting is generally done to control the spacing, quality, and species composition of the stand to attain the intended purpose of the practice.

Trees targeted for removal include:

- Suppressed trees that will not live until the next thinning.

Refer to NRCS Woodland Information Stick for guidance on the number and spacing of trees per acre remaining after improvement cuttings.

The length of time (cutting cycle) between intermediate thinning depends on the species being managed, the site index of the soil, and the volume necessary for an economically feasible harvest operation. In general, this cycle is the time it takes the average tree diameter to increase by 2 inches for pine and 4 inches for hardwood.

## 2. Harvest/Regeneration Cuts

Harvest and regeneration cuts are made when the forest stand has reached economic and/or physiological maturity. The harvest method used will be dictated by the type of new forest desired by the landowner. The harvest method will determine in large part the species composition of the new stand.

Harvest methods fall into two general categories: those encouraging regeneration of even-aged forest stands, and those resulting in uneven-aged stands. Even-aged stands are created through use of clearcuts, seed tree cuts, and shelterwood cuts. Uneven-aged stands result from selection cuts.

### (a) Clear Cut

Clearcutting removes all merchantable trees in the stand in one cut. This method is used when nearly all the desirable trees in the stand are mature and a new stand of shade intolerant trees species is desired. This method is often used when pine or yellow poplar is desired in the new stand. This type of regeneration harvest is often followed by site preparation (refer to Forest Site Preparation standard, Code 490) when seedling planting is used to establish the next stand.

The size, shape, timing, and duration of the clear cut are influenced by the abundance of desirable tree seed or advanced seedlings. Clearcutting an entire

stand at once may be done when there are sufficient desirable seedlings or established seedlings in place, or when the site is to be planted. Strip and block clear cutting is used when you must depend on production of seed from the uncut portion of the stand.

A clear-cut site is considered by some to be aesthetically unpleasing for a short period following harvest. Planning the size, shape, and location of the clear cut to blend more naturally with the landscape may lessen the initial negative impact.

### (b) Seed Tree Cuts

Seed tree cuts are most frequently used for regenerating pines. This method consists of leaving enough seed-producing trees scattered over the cut area to ensure adequate stocking. The seed trees are cut to eliminate competition when the new seedlings are two to three years old.

### (c) Shelterwood Cuts

Shelterwood cuts are similar to seed tree cuts, but more trees are left to regenerate the stand and to provide some shade for the developing seedlings. This method is frequently used to encourage establishment of oaks and other somewhat shade tolerant species. Forty (40) to sixty (60) percent of the basal area is removed in the first cut, depending on the initial stocking

density. The remainder of the overstory trees is removed once the desired reproduction has become fully established. This final cut is usually made five to ten years after the initial cut.

(d) Selection Cut

Selection harvesting involves periodic cutting of selected trees or groups of trees from all merchantable diameter classes. This type cutting maintains the existing age diversity of the stand. Since the openings created by this type of harvest are small, the new trees that become established are generally shade tolerant such as hemlock, beech, white pine, and maples.

(e) Salvage/Sanitation Cut

Salvage cutting is the removal of trees damaged by insects, disease, ice, tornadoes, fire, and other disasters so as to recover trees that have been damaged and will be lost if not harvested. Sanitation cuts are removal of insect or disease infested trees to suppress the further spread of the infestation. These cuts usually are an expense, but are necessary to protect the forest resource.

## REFERENCES

NRCS, National Forestry Handbook. Feb. 2001. (<http://nsscnt.nssc.nrcs.usda.gov/nfh/>).  
NRCS, National Forestry Manual. Sep. 1998.  
(<http://nsscnt.nssc.nrcs.usda.gov/nfm/>).

Society of American Foresters. Forestry Handbook – Second Edition. 1984.

## OPERATION AND MAINTENANCE

Periodic inspections during treatment activities are necessary to ensure that objectives are achieved and resource damage is minimized. Follow-up and on-going management activities will be needed to obtain desired results.